

REMARKS

Claims 1-27 were pending in this application. As a result of the above amendments, claims 1-27 have been canceled. Claims 28-77 have been added. No new matter has been added with the above amendments. Thus, claims 28-77 are now pending.

Applicant wishes to thank Examiner for the interview of October 6, 2004, at which time each of the objections and rejections raised in the Office Action as well as several potential new claims were discussed. While agreement was reached in relation to some of the objections and rejections, no agreement was reached which would put the application in condition for allowance at that time for all pending and suggested claims.

As an initial matter, in the Office Action the Examiner objected to "Figures A-C" which were believed to be added as figures in the amendment filed 3/29/04. In that Amendment, Applicant made arguments and Figures A-C were submitted as a part of such arguments, not as an official amendment to the application. Although formal figures were filed in relation to the original drawings, Figures A-C were not intended to be a part of the formalization of the original drawings. Thus, Applicant requests withdrawal of this objection.

Further within the Office Action, the Examiner objected to claims 22-27 (now canceled) in relation to wording within the preamble. The new claims no longer use the specific wording to which the Examiner previously objected. Specifically, the new claims have been amended so as to remove references to the terms "spectrometer" and "spectrometer rotor." In addition, the Examiner objected to claim 24 (now canceled), as a potentially redundant claim. This potential redundancy has been removed.

Further within the Office Action, the Examiner rejected claims 1-14 and 17-27 (all now canceled) under 35 U.S.C. sections 102 and 103(a) based on Saito and Ivory et al. The new claims of the amendments set out above clearly distinguish Saito and Ivory et al., as will be described below.

The new set of claims 28-77, includes three independent method claims (claims 28, 40 and 51), three corresponding apparatus claims (claims 57, 62, and 67) and a further device claim (claim 73) which generally incorporates the features of any one of the three independent apparatus claims. Each of the independent claims incorporates features which serve to distinguish such claims over the prior art as will be described below.

Independent claims 28 and 57 correspond to the embodiment in which an array of field shaping wires is provided along the channel with which to set up the electric field. This is described on page 12, lines 17 to 26 with reference to the separation of gas or vapor molecules. The description also makes clear that this technique can be used generally to provide the field shaping means in place of the shaped cavity or variable resistance wall shown at least in Figures 1 and 2 respectively (page 9 lines 12 to 13 and page 12 lines 27 to 28), and claimed in original claim 19. Therefore, no new matter is added with these claims.

New dependent claims 29 and 58 have been added which are directed to dynamically varying the applied electric field so as to control the migration of the objects during separation. This is described at least on page 6, line 26 to page 7, line 19. As described, the voltages (and so the electric field) can be varied while the separation is taking place. This has the effect of changing the range of charge over mass (q/m) values which may be separated in the channel. In other words, the user can vary the dynamic range of the spectrometer (see page 2, lines 11 to 21).

Dependent claims 30 to 39 correspond to original claims 2 to 11. Claims 59 to 61 correspond to original claims 17, 18, and 20.

Independent claims 40 and 62 relate to the embodiment depicted in Figure 1 of the application and include the features of original claim 15, which the Examiner has previously indicated would be allowable. The basis for this claim 40 is provided in at least original claim 1 and 15. Claim 60 is a combination of original claims 12, 13, and 15. Dependent claims 41 to 50 correspond to original claims 2 to 11 but have been made dependent upon claim 40. Dependent claims 63 to 66 correspond to original claims 16, 17, 18 and 20, and are made dependent on claim 62.

Independent claims 51 and 67 correspond to the new claims previously presented to the Examiner during the recent telephone interview referred to above. These claims are directed to a method of separating gas or vapor molecules and to the apparatus required to carry out such a separation. The basis for these claims may be found at least in the description at least page 12, lines 17 to 26 and original claims 1, 6, 12 and 21. Dependent claims 52 to 56 generally correspond to original claims 7 to 11 but have been amended for conformity with claim 51. Similarly, dependent claims 68 to 72 correspond to original claims 13, 17, 18, 19 and 20, made dependent on claim 67 and amended as appropriate.

Claims 73 to 77 correspond to original claims 22 to 27. The dependencies have been revised so as to cover all three of the claimed embodiments.

The methods and apparatus recited in the independent claims relate to techniques quite unlike those disclosed by Saito. Saito describes a complex procedure requiring a buffer solution of varying density in order to establish a substantially rectilinear electric field. As Saito explains in his second example, the methodology involved in preparing such a solution is long, complicated and ultimately inaccurate (column 4, lines 22 to 23). Further, the technique suffers from a number of disadvantages including the length of time needed for the desired potential gradient to be established and the inherent instability of that gradient once set up.

In a first aspect, the apparatus and methods of the present invention provide much more convenient means for applying an electric field of particular shape to a separation channel. Moreover, the presently disclosed techniques allow the field shape and magnitude to be controlled in real time and with high accuracy. This is achieved by applying an electric field using for example, the means recited in claim 28 or claim 40.

Specifically, claim 28 (and corresponding apparatus claim 57) requires the application of the electric field by field shaping electrodes disposed along the channel. Such a configuration is not envisioned, disclosed, or suggested by Saito, which only discusses exclusively his density gradient technique without reference to any alternatives. There is no teaching towards the use of field shaping electrodes. One of ordinary skill in this art, were he to try and improve Saito's technique, would likely concentrate his efforts on advancing the preparation of a buffer solution with varying density, not the application of the electric field by field shaping electrodes disposed along the channel. Thus, Saito in fact teaches away from the present invention.

In addition, this embodiment of the present invention lends itself particularly well to dynamic variation of the applied electric field as claimed in new claims 29 and 58. This step is not touched upon in Saito, whose apparatus would be unable to provide for such instantaneous adjustments since it would not be possible to adjust the density gradient of the buffer solution once the separation process was underway. In using an apparatus in accordance with the present invention, on the other hand, both the shape and intensity of the applied field can be tuned during the separating process as desired by the user. For example, the voltage applied to each field shaping electrode could be controlled so as to shift the q/m range "visible" in the separation

channel in order to view a different set of separated molecule bands or to move a particular band to a collection point. Alternatively, the q/m range could be stretched or compacted so as to change the resolution of the spectrometer. Such dynamic adjustments are not possible using the technique disclosed in Saito.

Independent claims 40 and 62 are directed to the embodiment shown in at least Figure 1, in which the width of the channel varies along its length. As appreciated by the Examiner, this configuration has not been envisioned, described or suggested in any of the prior art citations. The particular shape of the electric field can be controlled by selecting an appropriate shape for the edge 20 (page 7, lines 20 to 25). Unlike Saito, the desired field shape is established accurately and substantially instantaneously.

In another aspect of the present invention, separation of certain types of objects takes place, which could not feasibly be attempted using known techniques. Specifically, independent claims 51 and 67 are directed to a method of separating, and an apparatus for separating, gas or vapor molecules. As has been discussed with the Examiner, none of the cited prior art documents describe such a method or provide suitable apparatus for the separation of gas or vapor molecules. It is our understanding that based on the present art of record, the Examiner has indicated that these claims should be allowable.

The above amendments set out above also clearly distinguish any combination of Saito, Ivory et al., and Tolley et al. Specifically, in the Office Action, the Examiner has previously asserted that the use of a hydrodynamic force rather than a centrifugal force in Ivory et al. is irrelevant. Applicant respectfully disagrees with this assessment. As set out in detail in the response to the first Office Action, a hydrodynamic force is completely different from a centrifugal force. Not only does each arise by different means, requiring different apparatus and techniques, but each interacts with the objects to be separated quite differently. For example, the magnitude of the hydrodynamic force will depend on the shape of the object, whereas a centrifugal force depends only on the object's mass.

Further, for application of a hydrodynamic force, the object must be suspended in a fluid. This is clearly unsuitable for many types of particles, such as those that may react with the fluid or which, like the gas or vapor molecules mentioned above, could dissolve in the fluid. The Examiner suggests that these differences are immaterial to the grounds of rejection, and that the

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type of physical force which counteracts the electric force is unimportant. However, the claims do not recite “any” physical force, but instead specifically refer to a centrifugal force. It is improper of the Examiner to disregard this limitation in the claims. As explained in the previous response, one cannot simply substitute a centrifugal force for a hydrodynamic force. Not only is the method of generating a centrifugal force completely different from that required to establish a hydrodynamic force, but the shape of the applied electric field must be changed so as to allow the objects to achieve a stable equilibrium for this setting. Further, a person skilled in the art of centrifugal spectrometry would not combine the teaching of Saito with that of Ivory et al. or Tolley et al. There is no motivation or suggestion to combine the Ivory et al. or Tolley et al. references with Saito so as to arrive at the present invention. The Examiner may not use a theory of “obvious to modify” Saito, if not taught or suggested by Saito or the other references in the proper context, as such an argument is improper hindsight.

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CONCLUSION

In summary, Applicant believes that all of the pending independent claims, as well as the pending dependent claims, are novel and non-obvious over the cited prior art, for the reasons above-stated. Applicant requests reconsideration of the present application and a notification of allowance of the same. Applicant further requests the Examiner to contact the undersigned with any questions or concerns prior to the issuance of any further action in this application in order to expedite a resolution of any such question or concern.

Respectfully submitted,

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